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ABSTRACT

A study examined the role of phonological regression in the language learning patterns of two toddlers. The children's phonological development was measured by inventories of the words produced at the beginning and end of an eight-week period, and distinctions were made between regressions due to cognitive factors and those due to non-cognitive influences. Analysis revealed four rules producing regressions in one child's data, and another three in the second child's data. The first child's regressions all involved rules operating on phonologically defined classes, and the second child's regressions operated on specific lexical items. This suggests that for these children, phonological development was not a succession of steps, each bringing the learner closer to the ambient language. Rather than being incremental, regressions led to periods in which the children's ability apparently decreased relative to earlier stages. This process is in accordance with basic tenets of cognitively-oriented models. The findings provide dramatic evidence that children can discover patterns and will implement rules even at the expense of surface phonetic accuracy. (MSE)

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Regressions in the Phonological Development of Two Children

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The present study was motivated by the concern that many current models of phonology present an overly deterministic picture of phonological development (Kiparsky and Menn, 1977). Three of the most respected and widely accepted of these models are Jakobson's Structuralist theory (Jakobson, 1968), Generative Phonology (Chomsky and Halle, 1968), and Natural Phonology (Stampe, 1973). Within these theories, determinism takes the form of innate linguistic knowledge. Phonological acquisition is viewed as the unfolding of a genetically controlled program of development (Menn, 1983).

In recent years, investigators have challenged the above conception of child phonology. A principal reason for disenchantment has been the discovery of extensive cross-child variation. Contrary to Jakobson's predictions, children appear to vary in the order in which they acquire feature contrasts (Menn 1976, 1983). Contrary to Natural Phonology, all children do not appear to possess the same set of phonological processes (Edwards, 1979). Generative Phonology's claims are more general, and therefore more difficult to either prove or disprove; nonetheless, the existence of extensive individual differences does not lend support to deterministic claims of the model, the aspect of the theory at issue here.

Given the acknowledged existence of extensive cross-child variation, investigators face the challenge of modeling an acquisition process that is sufficiently flexible to permit variation across all known parameters, but at the same time is sufficiently powerful to bring children to some acceptable variant of the ambient language. Faced with this challenge, some investigators have chosen to work within modified versions of existing theories (Edwards and Shriberg, 1983; Moskowitz, 1970; Smith, 1973), while others have attempted to develop new frameworks (Macken and Ferguson, 1983; Menn, 1983; Schwartz, 1984).

The most widely discussed of the newer approaches is characterized by its emphasis on problem-solving aspects of phonological development. The problem-

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solving approach is most fully elaborated in three models: Interactionist-discovery Phonology (Kiparsky and Menn, 1977; Menn, 1976, 1983), Cognitive Phonology (Macken and Ferguson, 1983), and Constructivist Phonology (Schwartz, 1984; Schwartz and Leonard, 1982). In the present paper, the neutral terms "cognitively-oriented" and "problem-solving" will be used when referring to positions held in common by all three models.

A variety of types of evidence have been used to support cognitively-oriented models. Particularly strong support has been found in three areas, (1) the discovery of unusual segment and phonotactic patterns that appear to have arisen from children's attempts to solve phonological problems, (2) phonological selectivity, which appears to be a device that might serve to limit children's attention to a subset of phonological patterns in the ambient language, and (3) non-adult units of phonological organization, which appears to indicate children do not automatically have adult phonological parameters available to them.

The above classes of empirical data have served to establish the credibility of non-deterministic accounts. However, Macken and Ferguson (1983) and Menn (1983) have both contended that the strongest support for such theories may come from apparent regressions in phonological development, if such regressions can be shown to be the result of hypothesis testing on the part of children.

At present, few phonological analyses of regressions have been reported. Pioneering research and analysis appears in Menn (1976). Other well-known examples appear in Leopold (1947) and Smith (1973). Recently, Vihman and Velleman (pers comm.) have begun studying the phenomenon in children's earliest vocabularies. Phonological regressions reported in the literature appear to be of two general types: incorporation of isolated lexical items into the child's phonological system, as occurred in the oft-cited example of "pretty" in Leopold (1947), and rules reorganizing phonologically-defined classes, as appears to be the case with data presented in Menn (1976).

All agree that more data on phonological regressions are needed. The present paper attempts to address this research issue through longitudinal analyses of the phonologies of two children. The specific research question addressed is, do phonological regressions exist in the speech of the children?

Methods

The subjects were two children named Kylie and Jake. Table 1 presents background information on both children. Both children were raised in monolingual environments by caregivers who spoke Midwestern American English. Both subjects were in good health during the course of the study. Each subject was observed 3 times a week for 8 weeks. Individual sessions ranged from 3-4 hours. All observations were undertaken in the children's homes. The investigator brought the same set of toys to each session, and efforts were made to elicit words represented by the objects on a regular basis. Data were collected while playing, reading books, and during snacks.

Phonologically, Kylie's consonant inventory contained stops, nasals, anterior fricatives, [h], and glides. No type of consonant cluster occurred in three or more different words. In stressed syllables, kylie's phonology contained all the vowels of English, except those with r-coloring, which were completely absent. In unstressed syllables, her phonology showed the expected large number of neutralizations of vowel contrasts. Jake's surface inventory was similar to Kylie's, except for the presence of some additional affricates and consonant clusters.

To obtain a measure of phonological development during the period of the study, words produced in both the first and last five sessions were analyzed. For Kylie, 42% of these words contained phonological changes, mostly in the areas of consonant clusters and syllable-final consonants. In sharp contrast, only 3% of Jake's words showed such changes. An implication of this finding is that the period of the investigation involved relatively extensive phonological growth for Kylie, but not for Jake.

All productions were recorded on a Sony Cassette tape recorder using ZT microphones. Based on transcription from tape recordings, Intra-judge and inter-judge reliability, averaged over a variety of phonetic environments was, respectively, 96% and 87% for Kylie and, respectively, 96% and 89% for Jake.

Prior to analyses of regressions in the children's vocabularies, attempts were made to develop minimum criteria to help distinguish between regressions due to cognitive factors and those that might possibly due to non-cognitive influences. This was done to limit the analysis to the stronger examples. In addition to hypothesis-testing, possible sources of surface regressions were thought to be the collapsing of data that included spontaneous single words, sentences, and

Table 1. Basic statistics for the subjects (Kylie and Jake) in the investigation

	Kylie	Jake
Age	1;10:0-2;1:02	2;0:11-2;2:3
Siblings	2	none
ages	9 months 6 years	-
Parents	both natural parents	both natural parents
occupations	housewife student	students
Principle interactor during study	mother	father
M.L.U.	1.43	2.2
Hearing	speech: 10 dB warble: 15 dB	speech: 15 dB warble: 20 dB
M.P.D.I.[1]		
Gen. Devel.	2;1	2;6
Gross Motor	1;10	2;6
Fine Motor	2;6	2;7
Express. Lang.	2;1	2;8
Comprehension Conceptual	2;2	2;6
Comprehension Situation	1;9	2;6
Self Help	1;9	2;6
Personal-soc.	1;9	2;0

[1] - Minnesota Preschool Developmental Inventory

imitations and repetitions. Other less cognitive sources could be random phonetic variation and variation in language input to the subjects.

To remove the most obvious cases of regressions due to the above factors, data were limited to spontaneous single words not the result of imitation (operationally defined as five or fewer seconds between an adult model and a child's utterance) or repetition (operationally defined as less than ten seconds between a child's production of the same word. In the case of repetitions, only the first production was included in the data.). The most obvious instances of phonetic variation were removed by requiring potential regressions to be produced without phonetic variation in the parameter of interest on at least three occasions in both the pre-regression and regression stages.

Results

Even after imposing the above fairly stringent criteria, data from both subjects were found to contain developmental regressions. Kylie's data yielded four rules that produced regressions, and Jake's data yielded another three. Two of Kylie's rules serve to illustrate the general form of her productions. Discussion of one of Jake's rules will serve to illustrate the general form of his productions.

Kylie

Kylie's first rule involved Velar Regression. The rule operated in word-initial [+ stress] environments, turning velars into alveolars. As background for the rule, at the beginning of the study, in word-initial [+stress] environments Kylie produced adult-language velars in three ways, as velars, alveolars, and labials. The latter occurred in consonant clusters when the second C was [r]. In all other positions, adult language velars were almost always produced as velars, except under specific assimilation conditions.

The rule that led to Velar Regression operated on all velars that met the it's description. This included eight words, "Cookie Monster," "clown," "ok," "kitty cat," "cow," "cookie," "ice cream," and "Gumbi." "Cookie Monster," "clown," and "ok" met the numerical criteria established prior to the study to be labelled regressions. Table 2 charts the developmental course of word-initial velars in these words. Session numbers appear along the left and words involved in the regression appear along the top.

Table 2. Kylie's productions of [k] in "Cookie Monster," "clown," and "ok" indicating number of tokens occurring in each session

Session	Word	Tokens	Word	Tokens	Word	Tokens
	Cookie Monster		clown		ok	
1.	-		k	2	k	1
2.	k	2	k	2	k	2
3.	k	3	-		k	3
4.	-		~~g~~t	1/2	-	
5.	k	1	-		-	
6.	-		t	4	k	1
7.	k~t~p	1/2/1	t	1	t~d	1/2
8.	p	1	t	3	t	1
9.	t	3	k	1	t	1
10.	k~t	1/2	t	5	t	1
11.	t	1	t	3	t	1
12.	t	1	t	1	-	
13.	-		t	2	-	
14.	-		t	2	t	3
15.	t	2	t	1	t	1
16.	t	1	t	1	-	
17.	t	1	-		t	2
18.	t	1	-		t	1
19.	-		-		t	1
20.	t	1	t	3	t	1
21.	-		-		t	1
22.	t	1	t	2	t	1

All words undergoing rule: Cookie Monster, clown, ok, kitty cat, cow, cookie, ice cream, Gumbi

Table 3. Kylie's lexical entries for "frog" indicating number of times the word was produced per session

frog	fɔt/fɔg/fɔ	(6) 1/1/1
	fɔ/fɔg	(7) 1/1
	fɔ	(8) 1
	fɔg/fɔ/fɑg	(9) 1/1/1
	fɔg	(11) 1
	fɔg	(12) 1
	fɔg/fɑg	(13) 4/1
	fɔ̂gə	(15) 4
	fɔ,g/fɔgi	(16) 1/1
	fɔg	(17) 1
	fɔg	(18) 1
	fɔg	(19) 1
	fɔg	(20) 1
	fɔg/fɔ	(21) 2/1

All words undergoing rule: frog, flag, scared, pig, cold, bug, outside, swing

As the table indicates, the pre-regression stage for all three words occurred during the first two to three weeks of the study. During this period, six occurrences of word-initial velar in "Cookie Monster" were recorded. During the same period, four productions of [k] in "clown" and seven productions of velar in "ok" were obtained.

Reading left to right across the table, for "Cookie Monster" the regression began in session seven, when word-initial [k] began to alternate with [t] and [p]. [p] for adult-language [k] was highly atypical for Kylie. However, Kylie regularly produced adult-language C + [r] clusters as labials. For "clown," the regression began in session four, when [k] was replaced with Ø or [t]. Ø for word-initial [k] (or any consonant other than [h]) did not occur anywhere else in Kylie's data. For "ok," the regression began in session seven. [d] for [k] was produced in an inter-vocalic environment. Voicing was a minor process for Kylie in that position.

I interpret the child's unusual patterns of variation at the time when the regression began as attempts to find new ways to produce the words. After the initial phonetic instability, throughout the remainder of the study word-initial velars were regularly produced as [t]. Two weeks after completion of the study, I returned to see the subject. During this visit, I was able to elicit a number of words that contained initial velars in the adult language, including "clown." All were pronounced with velars by the child, suggesting that the regression stage had ended and the post-regression stage had begun.

Kylie's second rule added a schwa to words ending in voiced oral stops. The schwa induced resyllabification. The rule was operative in Kylie's phonology for approximately two weeks. During that period, eight of the twelve words that met the rule's description showed the pattern. The words were "frog," "flag," "scared," "pig," "cold," "bug," "outside," and "swing." "Frog" met the numerical requirement necessary to be labeled a regression. Table 3 lists the developmental course of this word. In this and the next table, the variants of words appear on the left, session numbers appear in parentheses, and number of tokens of variants appears between slahses.

As the table indicates, up till session fifteen "frog" was a one syllable word that ended with [g] or Ø. Sixteen tokens of this word were recorded. In session fifteen, "frog" became [fɔ́gə] for four productions. In the post-regression stage, "frog" again became a one syllable word. Eight productions of

Table 4. Jake's lexical entries for "orange" indicating number of times word was produced per session

orange	ɔIns/ɔInz	(1)	2/2
	ɔIns	(2)	1
	ɔIn/ɔIns	(3)	1/1
	ɔˈI.Ins	(4)	1
	ɔˈI.In	(5)	1
	ɔˈI.Ins	(8)	2
	ɔwIns	(9)	2
	ɔˈI.Ins	(10)	1
	ɔˈwIns	(11)	4
	ʃIyIns	(13)	1
	ɔˈIyɛns	(15)	1
	ɔˈIyɛns	(16)	1
	ɔˈIyɛns/ɔˈIyɹnz	(18)	2/1
	ɔˈI.yɛns	(19)	1
	ɔˈI.yɛns	(20)	1
	ɔˈI.yɛns	(21)	4
	ɔˈI.yɛns	(22)	1

the post regression behavior were recorded. In common with "frog," the seven other words that underwent the rule were produced as two syllable words during the period of the regression, and before and after the regression were always produced as one syllable.

Jake

While Kylie's regressions appeared to operate on classes of sounds, Jake's always involved incorporation of isolated words. The word "orange" illustrates the pattern. This word was pronounced [ɔrndʒ], by those adults with whom Jake came in contact. The regression involved loss of ability to say the word as a monosyllable.

Table 4 lists the developmental course of the word. As the table indicates, during the first week and one-half of the study (sessions 1-3), "orange" was produced on seven occasions as a one syllable word. For the remainder of the study, on 25 occasions the word was pronounced with two syllables. No one-syllable productions were recorded. [w] was the onset of the second syllable when the vowel in the first syllable was [ɔ], and, beginning in session 13 [y] was the onset of the second syllable when the vowel in the first syllable ended with a high front off-glide. It is relevant that elsewhere in Jake's phonology, syllables ending in the diphthongs [ɔI] and [aU] were regularly resyllabified, so that, for example, "boy" was pronounced [bɔ́Iyə] and "pow" was pronounced [páUwə].

Discussion

As mentioned earlier, Kylie possessed four rules that led to phonological regressions, and Jake possessed three. All of Kylie's regressions involved rules that operated on phonologically defined classes. Each of Jake's regressions operated on specific lexical items.

As regards Kylie's rule of Velar Regression, I speculate the rule may have arisen as an attempt by the child to reduce the number of different places of articulation. In the pre-regression stage Kylie had several ways to produce adult-language velar stops in word initial environments, as labials (in [r] clusters), alveolars, and velars (in a few singletons and clusters). As the regression began, the child experimented with several unusual pronunciations, and then settled on the constraint dominate in her

phonology: velar → alveolar. Similarly, near the same time, all velar + [r] clusters became labials.

The effect of the regression was to reduce the number of places of articulation that Kylie needed to produce in what was for her an important phonological environment. Finally, the post-regression stage, which began after completion of the study, appears to represent the child's recognition that the treatment of place of articulation was too undifferentiated for the language being acquired.

A similar interpretation might be given Schwa Addition. However, a difference between the rules is that the Schwa Addition rule did not exist prior to the regression. A possible interpretation of the rule is that it involved an attempt by Kylie to control voicing on obstruents in word-final environments. An interesting developmental question is whether the voiced obstruents in the pre and post regression stages had the same acoustic characteristics. Unfortunately, acoustic data were not collected as part of the study.

As regards Lexical Incorporation, the regression apparently arose from extension of an existing resyllabification rule. This rule extension may have functioned to permit Jake to produce a relatively complex phonetic sequence in "orange" by inserting a vowel between the diphthong and the nasal.

Conclusions

The most specific implication of the study is that for the subjects phonological development was not a succession of steps, each bringing the learner closer to the ambient language. Rather than being incremental, regressions led to periods in which the children's ability apparently decreased relative to earlier stages.

The children's regressions are in accordance with basic tenets of cognitively-oriented models. As stated in several places, such models emphasize the role of children's rule discovery abilities as factors in phonological development. Given this emphasis, it is incumbent on the theories to demonstrate that children possess sufficiently active cognitive processes to discover regularities in the ambient language. Apparent phonological regressions, when they plausibly can be shown to have arisen from hypothesis testing activities, provide dramatic evidence that children possess the ability to discover patterns, and that they will implement rules even at the expense of surface phonetic accuracy.

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